PATENT SPECIFICATION

DRAWINGS ATTACHED **892630**

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COMPLETE SPECIFICATION

Process for welding stretched foils of thermo-plastic artificial materials

We, FARBWERKE HOECHST AKTIENGESELLSCHAFT, vormals Meister Lucius & Brüning, a Company recognised by German Law, of (16) Frankfurt (M)-Hoechst, Germany, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:-

The present invention relates to a process for welding foils of thermoplastic artificial materials to which a high degree of molecular orientation has been imparted by so called "cold stretching" in both directions, i.e. stretching in both directions at a temperature below the crystallite melting point of the material, and the strength of which material is in all directions much superior to the strength of the commercial foils of the same material. The usual blown foils of low-pressure polyethylene, for example, have a strength of 200 to 250 kg/cm^2 whereas foils of the same material which have been cold stretched in both directions have a strength of 2,000 to 3,000 kg/cm^2.

uses additional stretching operation after the welding step

Foils that have been cold stretched and therefore strengthened to a high degree, can be welded by the known methods, for example by means of wedge-shaped heating bars or by thermal impulse heat sealing. These methods have the disadvantage that the high degree of strength of the stretched foils is lost at the welded seams and there becomes as low as the strength of the non-stretched material, since the molecular orientation to which the high degree of strength of the stretched foils is due is lost by the action of the welding heat. When, for example, a stretched foil of low pressure polyethylene of the above-mentioned kind is welded by a known method the strength of the foil produced in this case at the welded seam is not more than 200 kg/cm^2. The known processes do not enable the high degree of strength of the cold stretched foils to be maintained at the welded seams as is required in most cases.

The process according to the present invention is in part based on the observation that the strength of stretched foils at a welded seam can be maintained when the molecular orientation which has been imparted to the foil is maintained during the welding process by the application of appropriate measures.

The invention provides a process for welding foils of thermoplastic artificial materials which has been stretched and therefore strengthened. According to this process the foil to be welded is so prevented from shrinking during welding that, on the one hand, the orientation or state of stretching and, consequently, the high degree of strength, are substantially maintained in the heated zone and that, on the other hand, the welded joint obtained has a strength which is approximately equal to the strength of the stretched foil. The welding is effected at a temperature within the range from the crystallite melting point or softening point to a temperature which is about 20°C above the crystallite melting point or softening point.

The degree of stretching and consequently the strength of the stretched and strengthened foils that are used in the welding process of the invention may vary within wide limits. Their strength may be within the range of about 200 kg/cm^2 to about 3000 kg/cm^2.

The process of the invention can advantageously be carried out by subjecting the heated, plastic elastic welded seam immediately following the welding process

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to an additional stretching operation whereby the loss of strength caused by the shrinkage which to a certain extent is allowable and necessary for the welding process is compensated.

After the welding process the welding zone may be subjected to an additional cooling treatment.

It is also possible to heat the regions of the foils to be welded together before the welding so that a shorter heating time is required during the welding. The aforesaid heating should be effected only to such an extent that no damage is caused.

The following remarks are made with regard to the execution of the process of this invention.

In the process of this invention it is necessary to keep the temperature within a certain range. By using welding temperatures that are too much above the crystallite melting point the orientation of the foil is destroyed.

The welding temperatures applied in the usual processes for welding plastic materials and foils made thereof are about 100°C above the crystallite melting point or the softening temperature. Low-pressure polyethylene, for example, has a crystallite melting point of 127 - 130°C and is welded at 200°C (cf. Dr. E. Rottner, "Praktische Methoden zur Verarbeitung von Halbzeugen aus Niederdruck-Polyäthylen" in "Kunststoffe", 1957, page P 39). Polyvinyl chloride which has a softening point of about 80°C is generally welded at about 200°C.

The aforesaid welding temperatures are too high to be applied in the process of this invention for the foil would become plastic to such an extent that the tensions which are latent in the foil would lead to the formation of fissures. It is therefore necessary to carry out the welding at a temperature which is comparatively little above the crystallite melting point or softening point. When, for example, low-pressure polyethylene is welded, the temperature should be within the range of 128°C to about 145°C.

The observance of this low temperature range alone does not, however, of itself enable a high quality weld to be obtained. For if the edges of the foils that are to be welded together are laid one on the other, heated, for example by means of heating jaws, and pressed together, the foil, though it is not destroyed, undergoes a shrinkage towards the heated zone. This shrinkage results in a loss of orientation and strength. The process of the present invention enables cold stretched foils to be welded without any considerable loss of strength or orientation occurring at the welded seam, when in addition to keeping the temperature within a certain range the following measures are taken in carrying out the process of the invention.

The two edges of the foils to be welded together are laid one upon the other and, depending on the form of the welded seam chosen, they are secured at one or both sides. Welding is effected under pressure, for example by means of two heated dies, at a temperature within the aforesaid range. By the use of holding members for the foil a shrinkage of the foil in the heated zone and consequently a loss of its strength are substantially avoided.

When both foils are completely rigidly secured at both sides, no weld is obtained, for by the absolute maintenance of the state of orientation union of the molecules of the two surfaces is prevented. In order that a weld shall be obtained, a low degree of shrinkage has therefore to be allowed. Since each foil is in practice held at one side only (see Figures 1, 2 and 3 of the accompanying drawings to be referred to below) the free end of the foil which is covered by the other foil and pressed by the die can undergo the low degree of shrinkage that is necessary.

The process of the invention is applicable to the welding of foils of any normal thickness. The method is especially advantageous for foils having a thickness of 0.01 to 0.15 millimetre. The welding of foils is limited by thickness to the extent that an inadmissibly long time may be taken to heat the whole of a very thick foil.

The process of the invention is suitable for welding cold stretched foils of any thermoplastic material. It is especially suitable for foils that have been prepared from low-pressure polyethylene and polypropylene, co-polymers of ethylene and propylene and polymer mixtures of polyethylene and polypropylene and that have been stretched and thus strengthened in both directions.

Several apparatus suitable for use in carrying out the process of this invention are shown diagrammatically in the accompanying drawings by way of example.

Referring to the drawings, Figure 1 illustrates the welding of two foils 1 and 2. The numerals 3 and 4 represent holding members and 5 and 6 are heated dies. When a stretched foil of low-pressure polyethylene having a strength

of 1800 kg/cm^2 in both directions is welded according to the invention, the weld so produced has a strength of about 1700 kg/cm^2 calculated upon the cross-sectional area of foil.

Figure 2 shows the execution of another form of welded seam by which foils 7 and 8 are to be attached together. A holding member 9 is in this case arranged on one side only of heated dies 10 and 11. When the stretched foil of low-pressure polyethylene mentioned with reference to Figure 1 is provided with a welded seam according to Figure 2 the weld has a strength of about 1300 kg/cm^2. This form of seam is especially suitable as a sealing seam for bags.

Figure 3 shows the execution of another seam which is appropriate for the sealing of bags. The edges of foils 12 and 13 to be welded are placed within a weld band 14. The numerals 15 and 16 represent holding members, the numerals 17 and 18 represent heated dies. A foil of low pressure polyethylene having a strength of about 1300 kg/cm^2 when welded maintains this strength after the welding.

The following Example illustrates the invention:

EXAMPLE

A strengthened foil of polypropylene having a strength of 1350 kg/cm^2 was provided in one case with a welded seam as shown in Figure 1 and in another case with a welded seam as shown in Figure 2. In both instances the weld had a strength of more than 1350 kg/cm^2, that is to say that in a strength test the samples did not break at the welded seam but in the body of the material.

WHAT WE CLAIM IS:-

1. A method of welding films of thermoplastic artificial materials that have been strengthened by stretching, wherein welding is carried out at a temperature within the range from the crystallite melting or softening point of the film to about 20°C thereabove and the film is substantially prevented from shrinkage during the welding operation.

2. A method as claimed in claim 1, wherein the welded seam, immediately following the welding process is strengthened by stretching.

3. A method as claimed in claim 1 or 2, wherein the zone of the film that has been subjected to heating during welding is subjected after welding to a cooling treatment.

4. A method as claimed in any one of claims 1 - 3, wherein the parts of the film to be welded are pre-heated prior to welding.

5. A method of welding films of thermoplastic artificial materials as claimed in claim 1, conducted substantially as described herein and with reference to the accompanying drawings.

6. Welded film, when made by the method claimed in any one of claims 1 - 5.

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892,630 COMPLETE SPECIFICATION

/ SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1

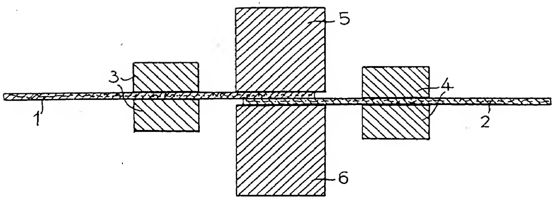

FIG. 2

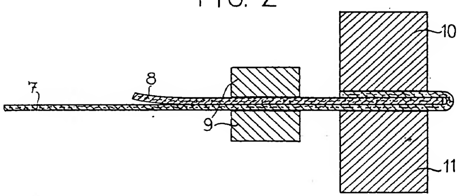

FIG. 3